N92-21674

STATIC AND DYNAMICAL MEISSNER FORCE FIELDS*

B.R. Weinberger and L. Lynds
United Technologies Research Center
East Hartford, CT 06108

J.R. Hull and T.M. Mulcahy
Materials and Components Technology Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439

The coupling between copper-based high temperature superconductors (HTS) and magnets can be represented by a force field. Zero-field cooled experiments were performed with several forms of superconductors: 1) cold-pressed sintered cylindrical disks, 2) small particles fixed in epoxy polymers, and 3) small particles suspended in hydrocarbon waxes. Using magnets with axial field symmetries, direct spatial force measurements in the range of 0.1 -10^4 dynes were performed with an analytical balance and force constants were obtained from mechanical vibrational resonances. Force constants increase dramatically with decreasing spatial displacement. The force field displays a strong temperature dependence between 20 K and 90 K and decreases exponentially with increasing distance of separation. Distinct slope changes suggest the presence of B-field and temperature-activated processes that define the forces. Hysteresis measurements indicated that the magnitude of force scales roughly with the volume fraction of HTS in composite structures. Thus, the net force resulting from the field interaction appears to arise from regions as small or smaller than the grain size and does not depend on contiguous electron transport over large areas. Results of these experiments will be discussed.

The practical implications are that machinable composite HTS structures with desirable strength, thermal and B-field properties can be produced. As an example, we will demonstrate a prototype magnetic rotor thrust bearing levitated over a modular composite HTS structure. Rotation is excited by a three phase square wave oscillator and the bearing can be operated at 20000 rpm.

* Work at the Argonne National Laboratory was performed under the auspices of the U.S. Department of Energy Superconductivity Pilot Center, Office of Energy Storage and Distribution, under Contract W-31-109-Eng-38.